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भारतीय मानक

दैनिक सौर प्रोफाइल की विश्लेषणात्मक अभिव्यक्ति

Indian Standard

ANALYTICAL EXPRESSION FOR DAILY SOLAR PROFILES

ICS 27.160

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BUREAU OF INDIAN STANDARDS
MANAK BHAVAN, 9 BAHADUR SHAH ZAFAR MARG
NEW DELH1110002

January 2010 Price Group 2

Solar Photovoltaic Energy Systems Sectional Committee, ETD 28

NATIONAL FOREWORD

This Indian Standard which is identical with IEC 61725 :1997 'Analytical expression for daily solar profiles' issued by the International Electrotechnical Commission (IEC) was adopted by the Bureau of Indian Standards on the recommendation of the Solar Photovoltaic Energy Systems Sectional Committee and approval of the Electrotechnical Division Council.

The text of the IEC Standard has been approved as suitable for publication as an Indian Standard without deviations. Certain conventions are, however, not identical to those used in Indian Standards. Attention is particularly drawn to the following:

a) Wherever the words 'International Standard' appear referring to this standard, they should be read as 'Indian Standard'.

b) Comma {,) has been used as a decimal marker in the International Standard while in Indian Standards, the current practice is to use a point (.) as the decimal marker.

Only the English language text of the International Standard has been retained while adopting it in this Indian Standard, and as such the page numbers given here are not the same as in the IEC Publication.

For the purpose of deciding whether a particular requirement of this standard is complied with, the final value, observed or calculated, expressing the result of a test, shall be rounded off in accordance with IS 2 :1960 'Rules for rounding off numerical values *(revised)'.* The number of significant places retained in the rounded off value should be same as that of the specified value in this standard.

Indian Standard

ANALYTICAL EXPRESSION FOR DAILY SOLAR PROFILES

1 Scope

This procedure provides a normative equation for analytically deriving a set of data points or a curve of irradiance versus time of day for a synthetic solar day.

The coefficients of the normative equation for the analytical solar irradiance profiles are determined from measured or estimated values of maximum solar irradiance, daily solar irradiation and the number of daylight hours. These three input data define the curve of the analytical solar irradiance profiles. Depending on the objectives, these data may represent, for example, the worst winter day of a certain place, or the average day of a summer season, etc.

CAUTION - While the results from the normative equation match measured clear sky data reasonably well, it is not intended to predict or simulate a real day. A daily solar irradiance profile is defined based on user-selected values for peak irradiance, daily irradiation and total daylight hours.

2 Definitions

The following symbols are defined and illustrated in figure 1:

G = solar irradiance, W.m-^{2}

G_{max} = the desired maximum solar irradiance at solar noon (t = 0), W.m-^{2}

H - daily solar irradiation, Wh.m-^{2}

H_d = the desired daily solar irradiation for the synthesized solar day profile, Wh.m-^{2}

t = time of day

$-t_0$ = time of sunrise

$+t_o$ - time of sunset

h = daylight hours (2.t$_0$), hours

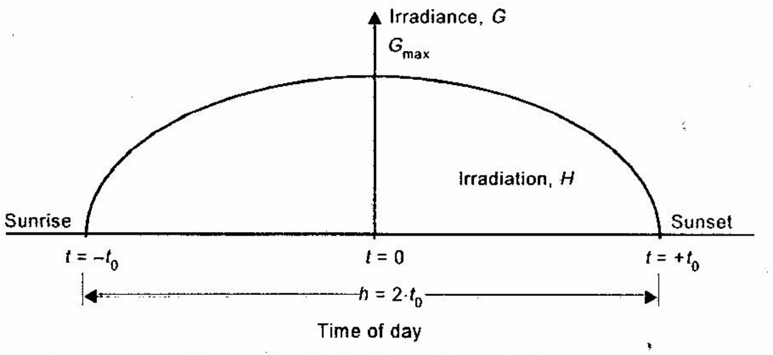

Figure 1 – Definition of symbols

3 Analytical solar irradiance profile

The normative equation defining the analytical solar irradiance profiles (see figure 2) is:

$$\frac{G}{G_{\text{max}}} = \cos\left(\frac{t}{t_0}\cdot\frac{\pi}{2}\right)\left[1+s\left\{1-\cos\left(\frac{t}{t_0}\cdot\frac{\pi}{2}\right)\right\}\right] \qquad (1)$$

where s, the shape factor, is given by:

$$s=\frac{d\cdot\frac{\pi}{2}-1}{1-\frac{\pi}{4}} \qquad (2)$$

where *d,* the data set factor, is given by:

$$d=\frac{H_{\text{d}}}{G_{\text{max}}\times h} \qquad (3)$$

The data set factor shall be within the range of validity specified in clause 4. If the data set factor is not valid, then the input data shall be checked for plausibility.

NOTE - If the daily solar irradiation value, *Ha,* is not available, set the shape factor, s, to zero. The resulting curve will then be a cosine distribution (type C, see figures 2 and 3).

4 Ranges of validity

To apply the normative equation (1) in a practical manner, the ratio, G/G_{max} shall be within the range:

$$0 \leq \frac{G}{G_{\text{max}}} \leq +1$$

The shape factor, s, shall be within the range: $-1 \leq s \leq +1$

and the data set factor, *d,* within the range: $0{,}5 \leq d \leq 0{,}77$ (see figure 3).

5 Examples

Figure 2 illustrates three example distributions.

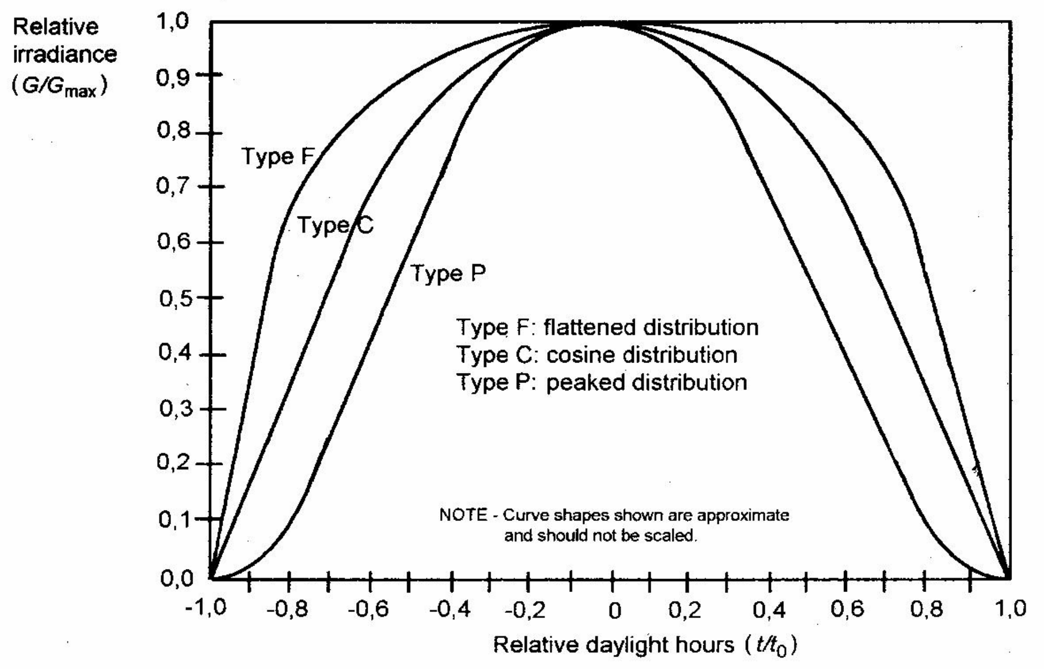

Figure 2 - Examples of analytical solar irradiance profiles

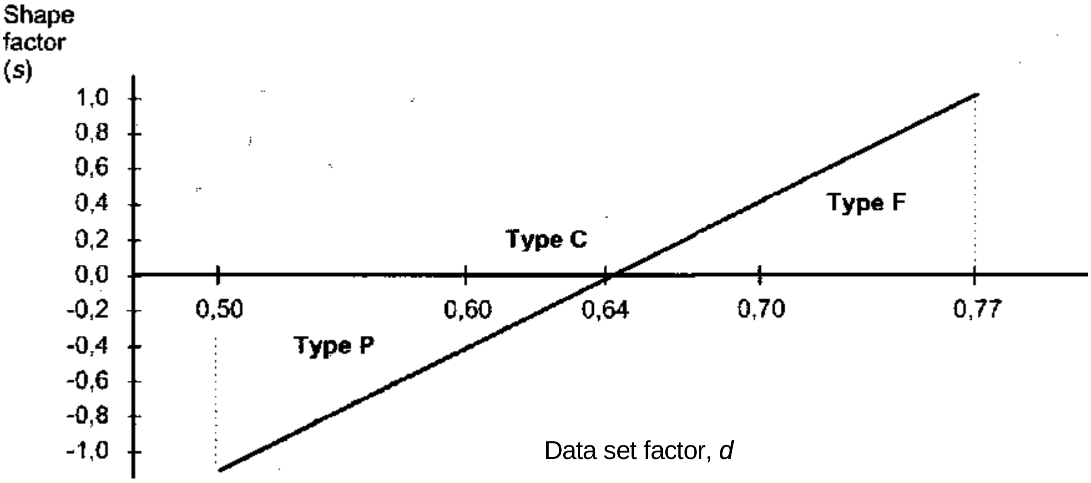

Figure 3 - Range of validity of the analytical solar irradiance profiles

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Amendments Issued Since Publication

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